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GIFFORD PINCHOT, Forester.

SILVICAL LEAFLET 46.

LIMBER PINE.

Pinus flexilis James.

Limber pine is usually a limby, crooked tree, and hence does not produce a high quality of lumber. It is valuable, however, for ties, posts, and mine timbers, since it is fairly durable in contact with soil. It is often an important component of protection forests on steep slopes endangered by erosion.

Limber pine closely resembles white-bark pine (*Pinus albicaulis*) which grows in the northern and western portions of its range. Both have their needles in clusters of five, but limber pine differs from white-bark in having larger cones and it grows, as a rule, at somewhat lower altitudes.

RANGE AND OCCURRENCE.

The range of limber pine extends from the summit and east slopes of the Continental Divide in Alberta and northern Montana, throughout the Rocky Mountains to southern Arizona, New Mexico, and western Texas, and through Utah and Nevada to the eastern slope of the Sierra Nevada and to the San Gabriel and San Bernardino mountains in southern California. The altitudinal range in Montana, Idaho, and Wyoming is from 4,000 to 10,000 feet; in Colorado from 6,500 to 11,500 feet; in Arizona and New Mexico from 7,000 to 10,000 feet; in Nevada and eastern California from 8,000 to 10,000 feet, and in southern California from 8,000 to 11,800 feet (timber line).

In Montana, Idaho, Wyoming, and Colorado it occurs on dry, rocky slopes and tops of ridges and foothills; in northern New Mexico on the sides of the moister canyons and hillsides; in Nevada on banks of mountain streams, and in eastern California on high exposed eastern slopes. It usually grows singly or in small groves among other conifers, but occasionally forms pure open forests on exposed slopes, benches, and ridges.

CLIMATE.

The wide range of limber pine subjects it to a variety of climatic conditions. The mean annual rainfall varies from 15 to 30 inches. Snow-

fall is usually heavy except in the extreme southern portion of its range. In the north the vegetative season is from 2 to 4½ months long. Absolute minimum temperatures vary from about 50° F. below zero in the north to 13° below in the south, and the absolute maxima throughout are from 90° to 100° F. The relative humidity of the air is low.

ASSOCIATED SPECIES.

Though it occasionally forms pure stands on exposed, dry slopes, limber pine grows most commonly in mixture with other species. Throughout the Rocky Mountains near its upper altitudinal limit, it invades the Engelmann spruce and alpine fir (*Abies lasiocarpa*) zone, while at lower altitudes it penetrates the yellow pine zone. In most parts of the Rockies it is also often found associated at moderate altitudes with Douglas fir and aspen, and in the northern and central Rocky Mountains is scattered sparingly among lodgepole pine. Near its upper altitudinal limits it also sometimes grows with whitebark pine, black hemlock, and alpine larch in the northern, and with bristle-cone pine in the southern Rocky Mountains. White fir (*Abies concolor*) associates with limber pine in the central and southern Rocky Mountains at moderate altitudes.

In Nevada and eastern California limber pine grows sparingly at lower altitudes with yellow pine, white fir, one-seed juniper, and scattered bristle-cone pine, and at higher altitudes with bristle-cone pine alone. In southern California it is found at timber line in mixture with lodgepole pine and at lower elevations associated sparingly with sugar pine and white fir.

HABIT.

Under moderately favorable conditions mature limber pine is not commonly over 40 or 50 feet high and 1 to 2 feet in diameter. Often it is only from 20 to 30 feet in height at maturity. Occasionally, however, it attains a height of 80 feet and a diameter of 4 to 5 feet.

The trunk is usually crooked and limby, has a rapid taper, and tends to branch in the crown. There are frequently several upright terminal branches instead of a single one. The branching is in irregular whorls, so that while the crown is in general conical, it is usually irregular and bushy, with a somewhat flattened top. It is about as wide as high, and covers from one-third to the full length of the trunk, depending upon the amount of side shade the tree receives.

The root system is superficial, but large and strong, with usually from 5 to 8 laterals 10 to 12 feet long. Taproots, if not altogether absent, are poorly developed.

The wood is rather soft, even-grained, and durable, and would make good lumber if it could be obtained in clear length without knots.

SOIL AND MOISTURE.

Limber pine grows on a wide variety of soils, and is not exacting as regards depth or moisture. Though it obtains its best development on moist, well-drained soils, it is usually found on dry, rocky ridges with shallow soil, and with little or no humus. In the Rocky Mountains it successfully competes with lodgepole pine on clay soils. It rises to higher altitudes on clay than on sandy soils, on which lodgepole has the advantage. On rocky hillsides with scanty, dry soils, it secures a firm foothold by forcing its strong lateral roots into crevices.

TOLERANCE.

It is a light-demanding tree; in this respect it ranks with white-bark and bristle-cone pines, and can not endure as much shade as any of the other pines, firs, and spruces with which it is found. Its need for light, together with the competition of its roots for moisture in the dry situations where it commonly grows, prevents it from forming dense stands.

GROWTH AND LONGEVITY.

Except in rich, moist soil limber pine grows very slowly. Trees 30 or 40 feet high and 16 or 18 inches in diameter breast-high are usually nearly or quite 150 years old. Ring counts on the stumps of full-sized specimens show that most of them are from 200 to 400 years old.

REPRODUCTION.

The seed-producing capacity of limber pine is moderate and varies considerably with region and altitude. In general, the tree bears cones most profusely when it grows in open stands at low altitudes; in denser, mixed stands at higher elevations it produces seed rarely. In favorable localities cones are borne annually. The seeds have short wings and are poorly fitted for wind dispersal. They are destroyed in large numbers by squirrels, which, however, are undoubtedly active in distributing them and thus aiding in the propagation of the species.

A mineral seedbed is the most favorable for germination, and in the Rocky Mountains reproduction occurs most commonly on clay soils. The seeds possess fair vitality and considerable germinative energy. Small openings made by fires or lumbering, where mineral soil is exposed, are especially adapted to the reproduction of limber pine, when there is sufficient moisture in the soil.

MANAGEMENT.

On account of its slow growth, small size, and knottiness, limber pine will never be in itself an important factor in forest management. Though its wood is useful for many purposes, it is not sufficiently abundant to

be of commercial importance except locally. However, in connection with several other species, it often has a decided value in protecting the soil from erosion; and, on steep exposed slopes, there should be very little or no cutting. Since the species with which limber pine associates usually exceed it in value, they should be given preference in the management of mixed stands.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *May 24, 1909.*

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